Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

5 Newton's laws of motion

Exercise C, Question 1

Question:

Use Newton's third law to explain why you would hurt your hand if you punched a hard object with it.

Solution:

The hard object exerts an equal and opposite force back on your hand!

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5 Newton's laws of motion

Exercise C, Question 2

Question:

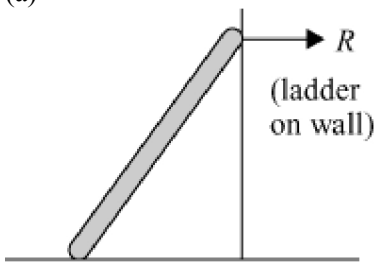
A ladder leans against a smooth wall.

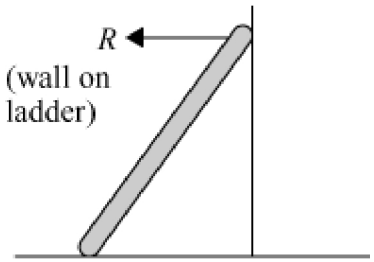
(a) Draw diagrams to show the force that the top of the ladder exerts on the wall and the force that the wall exerts on the top of the ladder.

(b) Use Newton's third law to explain why these forces have equal magnitudes.

Solution:

(a)





(b) If they are not equal and opposite, then there is a resultant force at the point and the ladder will move. Newton's third law says that they exert equal and opposite forces on each other.

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5 Newton's laws of motion

Exercise C, Question 3

Question:

A child jumps off a table and lands on the ground. Describe how the force that the ground exerts on the child varies. Also describe how the force that the child exerts on the ground varies.

Solution:

The higher the table jumped from, the larger the forces involved. Before landing there is no force between the child and the ground. On impact, the force exerted on the child by the ground increases and is upwards. Newton's third law says the force on the ground by the child is equal in size but is downwards. The magnitude of these forces increases (to decelerate the child) and then decreases again until the force exerted upwards by the ground on the child balances the child's weight.

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Exercise C, Question 4

Question:

A man, of mass 78 kg, stands in a lift of mass 200 kg that is accelerating upwards at 0.5 m s^{-2}. Calculate the magnitudes of the forces that act on the lift. Also draw a diagram to show how they act.

Solution:

Newton's 2nd Law ↑ for man

$R - 764.4 = 78 \times 0.5$

$\therefore R = 764.4 + 78 \times 0.5$

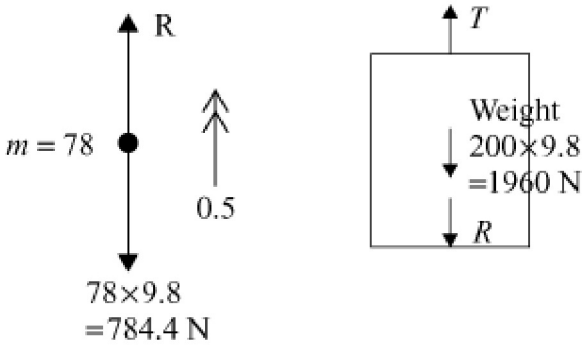
$R = 803.4$ N is the normal reaction between the lift and the man.

Newton's 2nd Law, ↑ , for lift $T - 1960 - R = 200 \times 0.5$

$\therefore T = 1960 + 803.4 + 200 \times 0.5$

$T = 2863.4$

$T = 2860$ N (3 s.f.)



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Heinemann Modular Maths for Edexcel AS and A-level

5 Newton's laws of motion

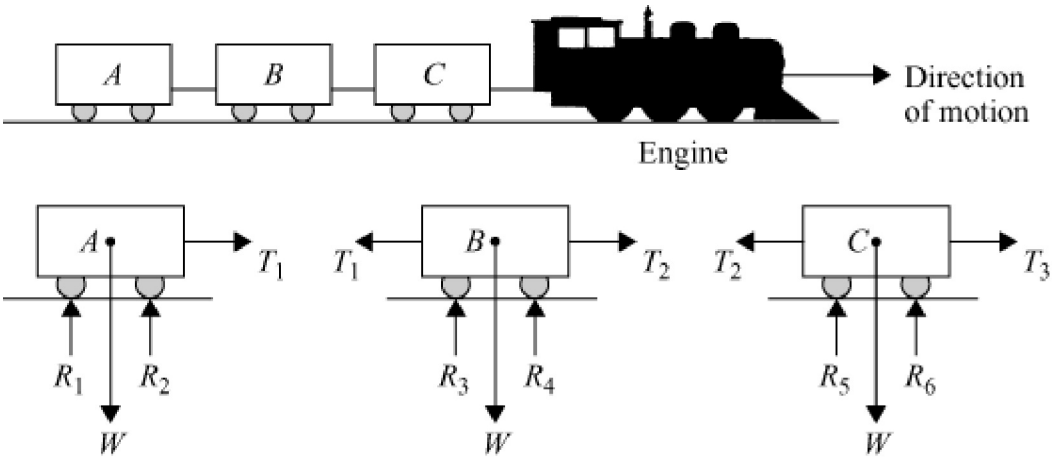
Exercise C, Question 5

Question:

Three carriages are coupled to an engine on a set of railway lines. The carriages and engine move forward on horizontal tracks. Draw diagrams to show the forces acting on each of the carriages. Clearly show any forces that have the same magnitude.

Solution:

For the situation on a straight track shown



The weights are the same provided the carriages are identical, then also R1 = R3 = R5 and R2 = R4 = R6. These will all be equal if the centre of mass is symmetrical between the wheels. All the tensions in the couplings are the same when the train travels at constant velocity.